Translation of Japanese patent 200728088

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]
An imaging means which picturizes object light,
A Lighting Sub-Division component extraction means to extract the Lighting Sub-Division ingredient from a taken image by said imaging means,
A reflectance component extraction means to extract a reflectance ingredient from said taken image,
A compression means which compresses a dynamic range of the Lighting Sub-Division ingredient extracted by said Lighting Sub-Division component extraction means based on the predetermined compression characteristic,
A picture generation means which generates a new picture from a compression Lighting Sub-Division ingredient for which said compression means comes to compress a dynamic range of the Lighting Sub-Division ingredient, and a reflectance ingredient extracted by said reflectance component extraction means,
While setting up at least two predetermined fields to said taken image or said Lighting Sub-Division ingredient, it has a compression characteristic setting-out means to set up said compression characteristic of emphasizing lightness difference between each field concerned,
An imaging device, wherein said compression means compresses a dynamic range of said Lighting Sub-Division ingredient based on the compression characteristic set up by said compression characteristic setting-out means.
[Claim 2]
The imaging device according to claim 1, wherein said compression characteristic setting-out means sets up the compression characteristic which inclination is zero and changes into the state where it was made to estrange by a predetermined compression amount mutually a portion corresponding to said each field of a characteristic line which shows the compression characteristic.
[Claim 3]
It has further a histogram preparing means which creates a luminance histogram of said taken image or the Lighting Sub-Division ingredient,
The imaging device according to claim 1 or 2, wherein said compression characteristic setting-out means sets up a prescribed range on luminosity in a luminance histogram as

said each field.
[Claim 4]
The imaging device according to any one of claims 1 to 3, wherein said compression characteristic setting-out means sets up said each field based on a picture of this prescribed range while setting up a spatial prescribed range in said taken image or said Lighting Sub-Division ingredient.
[Claim 5]
The imaging device according to claim 3 or 4 said compression characteristic setting-out means' computing a peak of said luminance histogram, and setting up a prescribed range consisting mainly of this peak or a peak near position as said each field.
[Claim 6]
A 1st level value setting-out means against said Lighting Sub-Division ingredient to set up the 1st level value more than main object luminosity which shows a predetermined luminance value of a main object,
It has further a 2nd level value setting-out means against said Lighting Sub-Division ingredient to set up the 2nd level value below the predetermined generating picture maximum according to reflectance in a high luminance region of said reflectance ingredient,
The imaging device according to any one of claims 1 to 5 setting up the compression characteristic which said compression characteristic setting-out means uses a predetermined region by the side of low-intensity [of said each field] as said 1st level value and the level, and uses a predetermined region by the side of high-intensity as said 2nd level value and the level.
[Claim 7]
The 1st process of picturizing object light by an imaging means,
The 2nd process of extracting the Lighting Sub-Division ingredient from a taken image by said imaging means by the Lighting Sub-Division component extraction means,
The 3rd process of extracting a reflectance ingredient from said taken image by a reflectance component extraction means,
The 4th process of compressing a dynamic range of the Lighting Sub-Division ingredient extracted by said Lighting Sub-Division component extraction means based on the predetermined compression characteristic by a compression means,
The 5th process of generating a new picture by a picture generation means from a compression Lighting Sub-Division ingredient for which said compression means comes to compress a dynamic range of the Lighting Sub-Division ingredient, and a reflectance ingredient extracted by said reflectance component extraction means,
While setting up at least two predetermined fields to said taken image or said Lighting Sub-Division ingredient, it has the 6th process of setting up said compression characteristic of emphasizing lightness difference between each field concerned, by a compression characteristic setting-out means,
An image processing method, wherein said 4th process is a process of compressing a dynamic range of said Lighting Sub-Division ingredient by a compression means based on the compression characteristic set up by said compression characteristic setting-out means.
[Claim 8]
The image processing method according to claim 7, wherein said 6th process is a process

of setting up the compression characteristic which inclination is zero and changes a portion corresponding to said each field of a characteristic line which shows the compression characteristic into the state where it was made to estrange by a predetermined compression amount mutually, by a compression characteristic setting-out means.
[Claim 9]
It has further the 7th process of creating a luminance histogram of said taken image or the Lighting Sub-Division ingredient by a histogram preparing means,
The image processing method according to claim 7 or 8, wherein said 6th process is a process of setting up a prescribed range on luminosity in a luminance histogram as said each field by a compression characteristic setting-out means.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention]
[0001]
This invention relates to the image processing method which may be applied to imaging devices, such as a digital camera, the imaging device which has a dynamic-range-compression function especially, and this.
[Background of the Invention]
[0002]
In recent years, in imaging devices, such as a digital camera, it is one big theme to make the luminance range of the photographic subject which an image pick-up sensor can treat, i.e., a dynamic range, (DR) expand with the request of high-definition-izing. By using the subthreshold level characteristic of MOSFET, concerning expansion of a dynamic range. The image pick-up sensor (it is called a linear log sensor) which has a photoelectric transfer characteristic which consists of an image pick-up sensor which has the characteristic that an electrical signal is changed in logarithm according to incident light quantity in the output characteristics by the side of high-intensity, i.e., a linear-characteristics field, and a logarithmic characteristic area is known. Since the output from which the linear log sensor was changed in natural logarithm to incident light quantity as mentioned above is obtained, a larger dynamic range is secured compared with the image pick-up sensor which has the photoelectric transfer characteristic of only a linear-characteristics field.
[0003]
While extensive dynamic range-ization of an imaging system progresses like the above-mentioned linear log sensor, even if extensive dynamic range-ization of the display system of a monitor etc. does not progress like an imaging system under the present circumstances but extensive dynamic range-ization of an inputted image is attained, In a display system, the effect can fully be demonstrated. Therefore, it is necessary to make the dynamic range of this inputted image compress so that the inputted image of an extensive dynamic range is settled in the dynamic range of a display system.
[0004]
By the way, for "compression of a dynamic range." The meaning which raises contrast (gradation) by adjusting the light and darkness of a picture locally, namely, compressing

the Lighting Sub-Division ingredient of a picture, and where the relation of the light and darkness of the whole picture is maintained as it was, Although there are two meanings with the meaning (a picture is uniformly compressed regardless of local light-and-darkness adjustment) which compresses a zone (dynamic range) literally, the former shall be called "color dodge processing" and the latter shall be called "DR compression" in order to distinguish these.

[0005]

the above from the Lighting Sub-Division ingredient concerned by which DR compression was carried out after extracting the Lighting Sub-Division ingredient, for example from a picture (a reflectance ingredient is also extracted at this time) and carrying out DR compression of this Lighting Sub-Division ingredient by color dodge processing conventionally, and a reflectance ingredient -- the new picture to which the light and darkness of the picture were adjusted locally is generated. With the art currently indicated by the patent documents 1, concerning this. These pictures are combined, after carrying out division extraction of the picture (it is henceforth called linearity / logarithmic picture) which has the photoelectric transfer characteristic of the linear characteristics and the logarithmic characteristic which were obtained by the linear log sensor at the log picture I1 and the linear picture I2 and performing color dodge processing by each picture, as shown in drawing 12. If this image composing is made into picture I' shown in drawing 13, DR compression to the source image I as an inputted image, i.e., above-mentioned linearity / logarithmic picture, will be performed so that this picture I' may be settled in the dynamic range of an outputted image (for example, the above-mentioned display system).

[Patent documents 1] Patent Application No. 2004-377875

[Description of the Invention]

[Problem(s) to be Solved by the Invention]

[0006]

However, in the art shown in the above-mentioned patent documents 1. By color dodge processing which is going to raise the contrast of the portion of the building 141 of a picture as the shade difference of the Lighting Sub-Division ingredient is shortened, namely, it is shown, for example in drawing 14, since the total luminance level of the Lighting Sub-Division ingredient is compressed uniformly. For example, the lightness difference of the empty 142 and the portion of the clouds 143 will become small (the empty 142 and the cloud 143 whole serving as what is called a picture that white-flew), and it will be a thin picture what is called with little contrast to which the contrast in the whole picture fell (picture). this -- drawing 15 -- being shown -- as -- being certain -- a picture -- ******** -- for example, -- about -- two -- twice -- luminance difference (difference D1 of the pixel value assumed) -- having -- luminosity -- A -- B (photographic subjects A and B) -- having seen -- a case -- Lighting Sub-Division -- an ingredient -- compression -- this -- luminosity -- A -- B -- it can set -- a pixel value -- A -- ' -- B -- ' -- a difference -- D -- two -- small -- becoming -- things -- depending .

[0007]

In light of the above-mentioned circumstances in color dodge processing, an object of this invention is to provide the imaging device and image processing method which can acquire the natural picture which could enlarge lightness difference of the Lighting Sub-Division ingredient in the necessary field of a picture, and was effective by extension.

[Means for Solving the Problem]
[0008]
An imaging means in which an imaging device concerning Claim 1 of this invention picturizes object light, A Lighting Sub-Division component extraction means to extract the Lighting Sub-Division ingredient from a taken image by said imaging means, A reflectance component extraction means to extract a reflectance ingredient from said taken image, and a compression means which compresses a dynamic range of the Lighting Sub-Division ingredient extracted by said Lighting Sub-Division component extraction means based on the predetermined compression characteristic, A picture generation means which generates a new picture from a compression Lighting Sub-Division ingredient for which said compression means comes to compress a dynamic range of the Lighting Sub-Division ingredient, and a reflectance ingredient extracted by said reflectance component extraction means, While setting up at least two predetermined fields to said taken image or said Lighting Sub-Division ingredient, Having a compression characteristic setting-out means to set up said compression characteristic of emphasizing lightness difference between each field concerned, said compression means compresses a dynamic range of said Lighting Sub-Division ingredient based on the compression characteristic set up by said compression characteristic setting-out means.
[0009]
According to the above-mentioned composition, object light is picturized by imaging means and the Lighting Sub-Division ingredient is extracted from a taken image by an imaging means by the Lighting Sub-Division component extraction means, While a reflectance ingredient is extracted from a taken image by reflectance component extraction means and at least two predetermined fields to a taken image or the Lighting Sub-Division ingredient are set up by a compression characteristic setting-out means, the compression characteristic of emphasizing lightness difference between each field concerned is set up. And a new picture is generated from a compression Lighting Sub-Division ingredient and a reflectance ingredient into which a dynamic range of the Lighting Sub-Division ingredient extracted [above-mentioned] by compression means based on the compression characteristic set up by a compression characteristic setting-out means was compressed into, and this dynamic range was compressed by picture generation means.
[0010]
An imaging device concerning Claim 2 sets up the compression characteristic changed into the state where said compression characteristic setting-out means made portion of each other [inclination is zero and] corresponding to said each field of a characteristic line which shows the compression characteristic estrange by a predetermined compression amount in Claim 1. According to this composition, the compression characteristic which inclination is zero and changes a portion corresponding to each field concerned of a characteristic line which shows the compression characteristic into the state where it was made to estrange by a predetermined compression amount mutually, by a compression characteristic setting-out means is set up.
[0011]
An imaging device concerning Claim 3 is further provided with a histogram preparing means which creates a luminance histogram of said taken image or the Lighting Sub-Division ingredient in Claim 1 or 2, and said compression characteristic setting-out

means sets up a prescribed range on luminosity in a luminance histogram as said each field. According to this composition, a luminance histogram of a taken image or the Lighting Sub-Division ingredient is created by histogram preparing means, and a prescribed range on luminosity in a luminance histogram is set up as each field by a compression characteristic setting-out means.

[0012]

As for an imaging device concerning Claim 4, in either of the Claims 1-3, said compression characteristic setting-out means sets up said each field based on a picture of this prescribed range while setting up a spatial prescribed range in said taken image or said Lighting Sub-Division ingredient. According to this composition, by a compression characteristic setting-out means, while a spatial prescribed range in a taken image or the Lighting Sub-Division ingredient is set up, each field is set up based on a picture of this prescribed range.

[0013]

In Claim 3 or 4, said compression characteristic setting-out means computes a peak of said luminance histogram, and an imaging device concerning Claim 5 sets up a prescribed range consisting mainly of this peak or a peak near position as said each field. According to this composition, by a compression characteristic setting-out means, a peak of a luminance histogram is computed and a prescribed range consisting mainly of this peak or a peak near position is set up as each field.

[0014]

A 1st level value setting-out means to set up the 1st level value more than main object luminosity an imaging device concerning Claim 6 indicates a predetermined luminance value of a main object over said Lighting Sub-Division ingredient to be in either of the Claims 1-5, It has further a 2nd level value setting-out means against said Lighting Sub-Division ingredient to set up the 2nd level value below the predetermined generating picture maximum according to reflectance in a high luminance region of said reflectance ingredient, Said compression characteristic setting-out means uses a predetermined region by the side of low-intensity [of said each field] as said 1st level value and the level, and the compression characteristic which uses a predetermined region by the side of high-intensity as said 2nd level value and the level is set up. According to this composition, by the 1st level value setting-out means, it is set up by the 1st level value more than main object luminosity which shows a predetermined luminance value of a main object over the Lighting Sub-Division ingredient, and by the 2nd level value setting-out means. The 2nd level value below the predetermined generating picture maximum according to reflectance in a high luminance region of a reflectance ingredient over the Lighting Sub-Division ingredient is set up. And by a compression characteristic setting-out means, a predetermined region by the side of low-intensity [of each field] is used as the 1st level value and the level, and the compression characteristic which uses a predetermined region by the side of high-intensity as the 2nd level value and the level is set up.

[0015]

The 1st process at which an image processing method concerning Claim 7 picturizes object light by an imaging means, The 2nd process of extracting the Lighting Sub-Division ingredient from a taken image by said imaging means by the Lighting Sub-Division component extraction means, The 3rd process of extracting a reflectance

ingredient from said taken image by a reflectance component extraction means, The 4th process of compressing a dynamic range of the Lighting Sub-Division ingredient extracted by said Lighting Sub-Division component extraction means based on the predetermined compression characteristic by a compression means, The 5th process of generating a new picture by a picture generation means from a compression Lighting Sub-Division ingredient for which said compression means comes to compress a dynamic range of the Lighting Sub-Division ingredient, and a reflectance ingredient extracted by said reflectance component extraction means, While setting up at least two predetermined fields to said taken image or said Lighting Sub-Division ingredient, Have the 6th process of setting up said compression characteristic of emphasizing lightness difference between each field concerned, by a compression characteristic setting-out means, and said 4th process, It is characterized by being the process of compressing a dynamic range of said Lighting Sub-Division ingredient by a compression means based on the compression characteristic set up by said compression characteristic setting-out means.

[0016]

In [according to the above-mentioned composition, object light is picturized by imaging means in the 1st process, and] the 2nd process, In [the Lighting Sub-Division ingredient is extracted from a taken image by an imaging means by the Lighting Sub-Division component extraction means, and] the 3rd process, In [a reflectance ingredient is extracted from a taken image by reflectance component extraction means, and] the 6th process, While at least two predetermined fields (the below-mentioned photographic subject luminosity area) to a taken image or the Lighting Sub-Division ingredient are set up by a compression characteristic setting-out means, the compression characteristic of emphasizing lightness difference between each field concerned is set up. And in [a dynamic range of the Lighting Sub-Division ingredient extracted / above-mentioned / by compression means in the 4th process based on the compression characteristic set up by a compression characteristic setting-out means is compressed, and] the 5th process, A new picture is generated by picture generation means from a compression Lighting Sub-Division ingredient and a reflectance ingredient into which this dynamic range was compressed.

[0017]

In Claim 7, an image processing method concerning Claim 8 said 6th process, It is characterized by being the process of setting up the compression characteristic which inclination is zero and changes a portion corresponding to said each field of a characteristic line which shows the compression characteristic into the state where it was made to estrange by a predetermined compression amount mutually, by a compression characteristic setting-out means. According to this composition, in the 6th process, the compression characteristic which inclination is zero and changes into the state where it was made to estrange by a predetermined compression amount mutually a portion corresponding to said each field of a characteristic line which shows the compression characteristic by a compression characteristic setting-out means is set up.

[0018]

An image processing method concerning Claim 9 has further the 7th process of creating a luminance histogram of said taken image or the Lighting Sub-Division ingredient by a histogram preparing means, in Claim 7 or 8, and said 6th process by a compression characteristic setting-out means. It is characterized by being the process of setting up a

prescribed range on luminosity in a luminance histogram as said each field. According to this composition, in the 7th process, a luminance histogram of a taken image or the Lighting Sub-Division ingredient is created by histogram preparing means, and a prescribed range on luminosity in a luminance histogram is set up as each field by a compression characteristic setting-out means in the 6th process.

[Effect of the Invention]

[0019]

Since according to the imaging device concerning Claim 1 the compression characteristic of emphasizing the lightness difference between at least two predetermined regions set up to the taken image or the Lighting Sub-Division ingredient is set up and the dynamic range of the Lighting Sub-Division ingredient is compressed based on this compression characteristic, In color dodge processing, the natural picture which could enlarge lightness difference of the Lighting Sub-Division ingredient in the necessary field of a picture, and was effective by extension can be acquired.

[0020]

Since the compression characteristic is set up by the method of changing into the state where made inclination to each field into zero, and it was made to estrange by a predetermined compression amount mutually according to the imaging device concerning Claim 2, the compression characteristic that the lightness difference between predetermined regions is emphasized can be obtained easily.

[0021]

Since the prescribed range on the luminosity in a luminance histogram is set up as each field according to the imaging device concerning Claim 3, when processing a picture, each field concerned can be easily set up using the luminance histogram generally created.

[0022]

Since the spatial prescribed range in a taken image or the Lighting Sub-Division ingredient is set up as each field according to the imaging device concerning Claim 4, For example, it becomes possible to set up each field and a part [a part] (each field) to make it emphasizing the lightness difference in a picture can be chosen now visually (intuitive) and easily because a user specifies a prescribed range to the taken image (or the Lighting Sub-Division ingredient picture) by which the monitor display was carried out.

[0023]

According to the imaging device concerning Claim 5, each field which used the luminance histogram can be easily set up by the method of setting up the prescribed range centering on the peak or peak near position of a luminance histogram as each field.

[0024]

According to the imaging device concerning Claim 6, the predetermined region by the side of low-intensity [of each field] can be used as the 1st level value and the level, and the compression characteristic that the lightness difference between each field is emphasized can be easily set up by the method of setting up the compression characteristic which uses the predetermined region by the side of high-intensity as the 2nd level value and the level.

[0025]

According to the image processing method concerning Claim 7, the compression characteristic of emphasizing the lightness difference between at least two predetermined

regions set up to the taken image or the Lighting Sub-Division ingredient is set up, Since the dynamic range of the Lighting Sub-Division ingredient is compressed based on this compression characteristic, in color dodge processing, the natural picture which could enlarge lightness difference of the Lighting Sub-Division ingredient in the necessary field of a picture, and was effective by extension can be acquired.

[0026]

Since the compression characteristic is set up by the method of changing into the state where made inclination to each field into zero, and it was made to estrange by a predetermined compression amount mutually according to the image processing method concerning Claim 8, the compression characteristic that the lightness difference between predetermined regions is emphasized can be obtained easily.

[0027]

Since the prescribed range on the luminosity in a luminance histogram is set up as each field according to the image processing method concerning Claim 9, when processing a picture, each field concerned can be easily set up using the luminance histogram generally created.

[Best Mode of Carrying Out the Invention]

[0028]

Drawing 1 shows the digital camera which is an example of the imaging device concerning this embodiment, and shows the Lord of this digital camera the rough block lineblock diagram about image pick-up processing. As shown in drawing 1, the digital camera 1 is provided with the lens part 2, the image pick-up sensor 3, the amplifier 4, the A/D conversion part 5, the image processing portion 6, the image memory 7, the control section 8, the monitor section 9, and the final controlling element 10.

[0029]

While the lens part 2 functions as a lens window which incorporates object light (light figure), The optical lens system (for example, it is arranged in in-series in accordance with the optic axis L of object light, they are a zoom lens, a focus lens, and other fixed lens blocks) for leading this object light to the image pick-up sensor 3 arranged inside the camera body is constituted. The lens part 2 is provided with the diaphragm (figure abbreviation) for adjusting the transmitted light amount of the lens concerned, or the shutter (figure abbreviation), and has the composition that the drive controlling of this diaphragm and shutter is made by the control section 8.

[0030]

According to the light volume of the object light image by which image formation was carried out in the lens part 2, photoelectric conversion of the image pick-up sensor 3 is carried out to the picture signal of R, G, and B each ingredient, and it is outputted to the latter amplifier 4. The linear-characteristics field which an output-picture-elements signal (output power signal generated by photoelectric conversion) is changed linearly, and is outputted as the image pick-up sensor 3 in this embodiment when sensor incidence luminosity is low (at the time of dark), When sensor incidence luminosity is high (at the time of **), the photoelectric transfer characteristic which consists of a logarithmic characteristic area where an output-picture-elements signal is changed in logarithm, and is outputted, and the log transformed type solid state image pickup device with which the low-intensity side has linearity and the high-intensity side has the photoelectric transfer characteristic of logarithm if it puts in another way are used. It changes and the point (it is

henceforth called the point of inflection) is arbitrarily made controllable by the predetermined control signal over each pixel circuit of the image pick-up sensor 3 of the linear-characteristics field of this photoelectric transfer characteristic, and a logarithmic characteristic area.

[0031]

The image pick-up sensor 3 specifically to for example, the solid state image pickup device which arranges optoelectric transducers, such as a photo-diode, to matrix form. The logarithmic transformation circuit provided with MOSFET of P type or N type, etc. is added, and what is called a CMOS image sensor from which the electrical signal was changed in logarithm to incident light quantity by using the subthreshold level characteristic of MOSFET in the output characteristics of the solid state image pickup device is adopted. However, they may be not only a CMOS image sensor but a VMIS image sensor, CCD series, etc.

[0032]

The amplifier 4 amplifies the picture signal outputted from the image pick-up sensor 3, and is provided with an AGC (automatic gain control) circuit, for example, performs gain (amplification factor) adjustment of the output signal concerned. The amplifier 4 may be provided with the CDS (correlation double sampling) circuit which reduces the sampling noise of the picture signal as an analog value besides an AGC circuit.

[0033]

The A/D conversion part 5 changes into the picture signal (digital signal) of a digital value the picture signal (analog signal) of the analog value amplified with the amplifier 4, and changes into 12-bit picture element data the pixel signal acquired by receiving light by each pixel of the image pick-up sensor 3, respectively.

[0034]

The image processing portion 6 performs various Image Processing Division called the gray-scale-conversion processing based on the color interpolation/color correction processing and white-balance-correction processing to the picture signal acquired by the A/D conversion processing by the A/D conversion part 5, and the color dodge processing which are the focus when this embodiment is main especially. This gray-scale-conversion processing in the image processing portion 6 is explained in full detail behind. The image processing portion 6 besides each above-mentioned function part, For example, it may have the black reference amendment part (all are graphic display abbreviation) etc. which amend the black level of the digital image signal inputted from the FPN amendment part which removes the fixed pattern noise (FPN;Fixed Pattern Noise) of a signal, or the A/D conversion part 5 to the value of a standard.

[0035]

The image memory 7 consists of memories, such as ROM (Read Only Memory) and RAM (Random Access Memory), and saves the image data etc. to which Image Processing Division was performed by the image processing portion 6. The image memory 7 is a thing with the capacity which can memorize the image data for a photography **** prescribed frame, for example.

[0036]

The control section 8 consists of reading ROM which memorizes various control programs etc., RAM which stores data temporarily, a control program, etc. from ROM, and executing them (central processing unit: CPU) etc., and manages the motion control

of the digital camera 1 whole. The control section 8 computes the control parameter etc. which each part of a device needs based on the various signals from each part of a device of image pick-up sensor 3 grade, and controls operation of each part of a device via a timing generator or an actuator (all are graphic display abbreviation) based on this. The control section 8 controls processing operation in gray-scale-conversion processing of the image processing portion 6, such as the Lighting Sub-Division ingredient compression processing and a characteristic conversion process, especially in this embodiment.

[0037]

The monitor section 9 performs monitor displays, such as a picture saved at the picture or the image memory 7 photoed by the image pick-up sensor 3. Specifically, the monitor section 9 consists of a liquid crystal display (LCD;Liquid Crystal Display) etc. which consist of an electrochromatic display display device allocated by the camera back, for example.

[0038]

The final controlling element 10 performs the operator guidance input by the user to the digital camera 1, and consists of various kinds of operation switch groups (manual operation button group) which set up an electric power switch, a release switch, or various photographing modes, such as a mode setting switch and a menu selection switch. For example, by the depression (one) of the release switch being carried out, object light is picturized by the imaging operation 3, i.e., an image pick-up sensor, and after necessary Image Processing Division is performed to the image data obtained by this image pick-up, a series of photographing operation of being recorded on image memory 7 grade is performed.

[0039]

Here, the details of the composition of the image processing portion 6 about the function of the above-mentioned gray-scale-conversion processing and operation are explained. Drawing 2 is a functional block diagram for explaining each function of the image processing portion 6. As shown in the figure, the image processing portion 6, The main object luminosity acquisition part 61, the characteristic converter 62, the Lighting Sub-Division component extraction part 63, the compression starting point set part 64, the reflectance ingredient calculation part 65, the high luminance region reflectance calculation part 66, the maximum luminance compression point calculation part 67, the histogram operation part 68, the photographic subject luminosity area setting part 69, the Lighting Sub-Division ingredient compression zone 70. And it has the image generation part 71.

[0040]

The main object luminosity acquisition part 61 acquires the main object luminosity of the taken image (source image I) obtained by the image pick-up by the image pick-up sensor 3 (calculation). As shown in drawing 8, the main object luminosity acquisition part 61 with for example, a matrix metering (multi-pattern light measurement) method. The center region (it is called the main object area 610) which it comes to divide into 36 detection blocks of an A-AJ block in the imaging region 600 I, i.e., a source image, for example, the 1- it divides into two or more divisions which consist of adjacent spaces (it is called the circumference photographic subject field 620) which it comes to divide into 16 block [16th] detection blocks, and main object luminosity is computed as average luminance from the brightness information detected from the picture of each of this

division. In this case, while computing the main object luminance histogram (distribution) for every A-AJ block, for example, The whole main object luminance histogram in the main object area 610 whole may be computed from the main object luminance histogram for this the A-AJ block of every, and the average luminance to the main object area 610 may be computed from this whole main object luminance histogram. In the case of this average luminance calculation, "cut-off point" processing of luminance data may be performed, for example using a certain predetermined threshold, and the brightness information (a circumference photographic subject luminance histogram and the whole circumference photographic subject luminance histogram) of a circumference photographic subject field may be used. The calculating method of main object luminosity is not limited to the above-mentioned thing, but various methods can be used for it. Main object luminosity is not computed as average luminance, but ** is also good, for example, it may compute it as the maximum/the minimum luminance.
[0041]
Here, drawing 3 is the graph charts explaining the color dodge processing (compression of the Lighting Sub-Division ingredient) by the above-mentioned gray-scale-conversion processing. The characteristic converter 62 performs processing (characteristic unification processing) to the source image I which has a photoelectric transfer characteristic which consists of the linear characteristic 301 and the log characteristic 302 which unifies the characteristic, as shown in drawing 3. This source image I is an inputted image from the image pick-up sensor 3, and has an expression of relations (photoelectric transfer characteristic) of the pixel value y over the input luminosity x as shown in the following (1) and (2) types. However, the coordinate point (Xth, Yth) in the figure shows the point of inflection 303, (1) type shows the picture I2 which is the linear characteristic 301, and (2) types show the picture I1 which is the log characteristic 302. The sign "*" in a formula shows multiplication and a, b, alpha, and beta show a predetermined coefficient (the following is also the same).
y=a*x+b (0 <=x<=Xth) ... (1)
Y=alpha*log (x)+beta(x>Xth ... (2)
[0042]
The characteristic converter 62 performs here processing which changes the log characteristic 302 into the linear characteristic 304 which is the same characteristic as the linear characteristic 301. In this case, if the pixel value of the image pick-up sensor 3 is set to i, the picture (picture It shown in the numerals 310) which has a photoelectric transfer characteristic which consists of the linear characteristic 301 and the linear characteristic 304 which are acquired by the characteristic unification processing concerned will be given by the conversion based on the following (3) types. However, the sign "/" in a formula shows division (the following is also the same).
if(i>Yth)
It=a*exp(i-beta) (/alpha) +b
else
It=i ... (3)
[0043]
The characteristic converter 62 performs conversion to the linear characteristic 304 from the above-mentioned log characteristic 302 using predetermined LUT (it is called conversion LUT). This conversion LUT may be memorized to the LUT storage parts

store (graphic display abbreviation) with which the characteristic converter 62 was equipped.

[0044]

The Lighting Sub-Division component extraction part 63 extracts the Lighting Sub-Division ingredient from the picture It (linear picture) acquired by the above-mentioned characteristic unification processing. When according to what is called Retinex theory this picture It uses the Lighting Sub-Division ingredient in this picture It as the Lighting Sub-Division ingredient L and a reflectance ingredient is used as the reflectance ingredient R, it is expressed with the following (4) types. It shall treat suitably as a thing showing the Lighting Sub-Division ingredient L which extracted the straight-line graph shown in the picture It from this picture It.

It=L*R ... (4)

[0045]

Extracting processing of the Lighting Sub-Division ingredient L from this picture It is performed using what is called edge maintenance filters (nonlinear filter), such as a median filter and an epsilon delta technique (epsilon) filter. This is expressed with the following (5) types.

L=F (It) ... (5)

However, "F" in (5) types shows the above-mentioned edge maintenance filter. In usual LPF (low pass filter; linear filter) in a narrow sense which only passes a low-frequency component. Since the change cannot be correctly extracted on the Lighting Sub-Division boundary (edge) of a picture, That is, since an artifact (portion which a picture is dark and sank) will appear if DR compression is performed based on the signal extracted using the linear filter for example, the edge maintenance filter which such a problem is avoided and can extract edge correctly is used.

[0046]

The compression starting point set parts 64 are the compression starting point S shown in the numerals 305 for performing compression processing to the Lighting Sub-Division ingredient L extracted from the described image Tt, and a thing (the compression start level Xs at the time of seeing by input luminosity may be set up) which specifically sets up the compression start level Ys. In this case, the compression start level Ys is set up become a value more than the main object luminosity given with the above-mentioned average luminance etc. As a method of setting up the compression start level Ys used as the value more than this main object luminosity, it is good also considering the value which carried out predetermined number double [of the value of main object luminosity], for example as the compression start level Ys. If a gamma correction is performed when a main object serves as people's face, for example, when about 2 to 3 times used as the level with which a proper luminosity is obtained, or a main object will serve as scenery, one (magnification) these times the concrete value of a predetermined number is good also as about 2 times. However, magnification is not limited to these but can adopt arbitrary values. This magnification may be set up as one fixed value computed according to the photographic subject assumed beforehand, and a different thing may be set up each time according to a photographic subject. In this case, for example, may set up what was chosen from two or more fixed values based on the indicating input from the final controlling element 10 by a user, and. May set up what was automatically chosen from two or more fixed values according to the value of the main object luminosity for which

it asked from the photometry result in the above-mentioned main object luminosity acquisition part 61, and, It may set up according to the kind of main object identified by the photographing mode (for example, "portrait (person)" mode and "scenery" mode) called for from the photometry result concerned and photographing magnification (focal distance). Anyway, the compression start level Ys is suitably set up according to the classification and brightness information of a main object (photographic subject), and the predetermined value from not a main object luminance level (or this latest level) but main object luminosity -- it is preferred to set it as a high level, and, thereby, it becomes possible to prevent more certainly the influence on the main object by DR compression irrespective of the difference among various photographic subjects.

[0047]

As a method of setting up the compression start level Ys used as the value more than main object luminosity, The predetermined luminance histogram based on [it is not limited to what was mentioned above, for example,] the brightness information of a main object and/or a circumference photographic subject (henceforth) only -- a "histogram" -- saying -- it may compute and the predetermined level in the field more than main object luminosity, for example, a luminance value with little frequency, (luminance level) may be set up as the compression start level Ys. The histogram is carrying out the so-called shape of the "mountain", for example, and supposing near [this] a crest point is main object luminosity, specifically, it will set up so that the frequency more than the main object luminosity in this histogram may make the position neighborhood at the base of a mountain which is small a compression start level. Thus, by compressing by making a luminance value with little frequency into the compression start level Ys, (since the compression to a portion with big frequency in a histogram is avoidable), change of a gradation characteristic can be made not conspicuous. Setting out of the compression start level Ys based on this histogram may be performed whenever [capital / where a taken image is obtained by the image pick-up sensor 3].

[0048]

As an image pick-up sensor shows this embodiment, when it is a linear log sensor, the value which interlocked the compression start level Ys with the point-of-inflection level Yth by asking, for example as Ys=Yth*P (predetermined multiple value smaller than P; 1) may be set up. The point-of-inflection level Yth is a stage where automatic exposure control (AE control) by the digital camera 1 is performed, that is, is a preceding paragraph story on which color dodge processing here is performed, and this is because it is set as a bigger value than a main object luminance level. The above-mentioned AE control is performed using the evaluation value for AE control (AE evaluation value) calculated from the taken image in the image processing portion 6. Even if it uses any of the above, the compression start level Ys should just be set as the level that DR compression of the main object luminosity is carried out, and in short the gradation of a main object is not crushed.

[0049]

The reflectance ingredient calculation part 65 computes the reflectance ingredient R from the picture It (extraction). This reflectance ingredient R is computed by the following (6) types using the above-mentioned Lighting Sub-Division ingredient L.

R=It/L ... (6) (from the above-mentioned (4) formula to derivation)

[0050]

The high luminance region reflectance calculation part 66 computes the reflectance Rhi of a high luminance region (high luminance part) from the reflectance ingredient R computed by the reflectance ingredient calculation part 65. Specifically, the high luminance region reflectance calculation part 66 computes the maximum or the average value of reflectance in the high luminance region which is beyond the threshold th predetermined in the value of the Lighting Sub-Division ingredient L (refer to drawing 3) among the reflectance ingredients R as the reflectance Rhi. Arbitrary calculating methods, such as creating the histogram of a reflectance ingredient, for example and computing based on this histogram (in the case of calculation with this histogram, what is called a "cut-off point" may be performed with a certain threshold), can be used for this maximum and average value. What carried out the arithmetic average of the whole reflectance ingredient of the field beyond the above-mentioned threshold th, and asked for it may be sufficient also as this average value, and it may be average value calculated by the average methods other than this. As the above-mentioned conventional technology (refer to drawing 9) explained the above-mentioned threshold th, the value with which the reflectance ingredient for which a pixel value exceeds the output maximum Omax may be included by the reflectance ingredient in the brightness area beyond this threshold th is set up. This threshold th may be set up as a certain fixed value, and whenever a taken image is obtained, it may be set up according to predetermined setting reference information.

[0051]

The maximum luminance compression point calculation part 67 computes maximum luminance compression point M' shown in the numerals 306 based on the reflectance Rhi computed by the high luminance region reflectance calculation part 66 (setting out). After DR compression according [this maximum luminance compression point M'] to the below-mentioned Lighting Sub-Division ingredient compression zone 68, . Are set up so that the reflectance ingredient R of a high luminance region may not serve as a bigger value than the output maximum Omax. Namely, the Lighting Sub-Division ingredient L with the dynamic range of 0 (zero) - Ymax (linear-characteristic maximum). It is a point (Xmax, L'max) which shows Lighting Sub-Division compression level L'max of the maximum luminance Xmax set up fit in the dynamic range of 0 (zero) - L'max by DR compression. Specifically, the maximum luminance compression point calculation part 67 computes the value of L'max by the following formulas (7.3) from the reflectance Rhi and the output maximum Omax. However, a formula (7.3) is drawn from the formula based on picture I' mentioned later being a value below Omax (7.1), and the formula based on picture I' in this (7.1) formula being a multiplication value of Lighting Sub-Division ingredient L'max and the reflectance Rhi (7.2).

I'<=Omax ... (7.1)

L'max*Rhi<=Omax ... (7.2)

L'max<=Omax/Rhi ... (7.3)

[0052]

The histogram operation part 68 performs the various operations based on this histogram information while creating a histogram based on the brightness information of a taken image. Specifically, the histogram operation part 68 creates the histogram of the Lighting Sub-Division ingredient (Lighting Sub-Division ingredient picture) extracted from the taken image like the graph shown in the numerals 410 of drawing 4 (this histogram is

called whole histogram to the below-mentioned peak histogram). By and the thing to cut off to this created whole histogram (cut-off point operation), predetermined threshold, i.e., cut-off point level. The histogram (it is henceforth called a peak histogram) more than a cut-off point level is computed, and the peak (peak value) in this peak histogram is computed further. Here, the peak histogram in the whole histogram shown in the numerals 410 like the graph shown in the numerals 420 of drawing 4, The two peak histograms 412 corresponding to the photographic subject B which has the peak histogram 411 and the luminosity B corresponding to the photographic subject A which has the luminosity A are obtained, and the peak of these peak histograms 411 and 412 has become the peak P1 and P2, respectively.

[0053]

The photographic subject luminosity area setting part 69 sets up a predetermined luminance range (predetermined region) as photographic subject luminosity area based on the peak histogram information or peak information computed by the above-mentioned histogram operation part 68. Here, as shown in the graph of the numerals 420, the peak P1, the photographic subject (good also considering peak P1 and P2 near position as center) luminosity area A1 centering on P2, and A2 are set up. Setting out of the photographic subject luminosity area concerned asks for the standard deviation sigma about the luminosity of this peak P1, a peak position like P2, or a peak near position, It may set up by the method of making width of **Nsigma (the value of N> 0, for example, 3) photographic subject luminosity area, and the big luminance range by a predetermined luminance value may be set up in plus and the minus direction by the method of making it into photographic subject luminosity area from a peak position or a peak near position. The size for this predetermined luminance value may be computed, for example from peak luminance or the total frequency of a peak histogram. Anyway, if the necessary photographic subject luminosity area corresponding to peak histogram information or peak information is obtained, arbitrary setting methods are employable. If each photographic subject luminosity area may become that which adjoined mutually (the interval of photographic subject luminosity area being narrow) and it puts in another way, each above-mentioned peak histogram, It may adjoin mutually and the compression characteristic part shown when setting up the compression characteristic in this case in the feeling 312 of photographic subject luminosity area, for example, the below-mentioned numerals, may serve as a steep slope.

[0054]

however, there being no peak histogram more than the above-mentioned cut-off point level, or, when it is one (when it is not two or more), When a clear peak is not acquired from what etc. the histogram is uniformly distributed for (the bias has not arisen to frequency), not DR compression performed by setting up the photographic subject luminosity area concerned but DR compression based on the compression characteristic shown in the numerals 320 is performed. Since the picture in which, as for this, a peak does not exist is a picture which does not have contrast originally, it is because DR compression performed by setting up the photographic subject luminosity area concerned is made unnecessary. the above -- predetermined peak histogram pattern information (information on the shape of Yamagata of a peak histogram) is memorized, for example, and distinction of whether to be a clear peak may be performed by comparing with this information. When two or more peaks exist, for example in one peak histogram, it is

good also as composition which computes the average value of these peak values and computes this average peak value as one peak representing this peak histogram.
[0055]
The Lighting Sub-Division ingredient compression zone 70 performs DR compression to the Lighting Sub-Division ingredient L extracted from the picture It by the Lighting Sub-Division component extraction part 63. In this DR compression, the Lighting Sub-Division ingredient compression zone 70 sets up the predetermined compression characteristic based on the information on the information on the above-mentioned compression starting point S, maximum luminance compression point M', and photographic subject luminosity area, and performs this DR compression based on this compression characteristic. Here, an example of the setting method of this compression characteristic is explained below.
[0056]
The Lighting Sub-Division ingredient compression zone 70 determines the compression characteristic in the field more than compression start level Ys based on the information on the photographic subject luminosity area (here, referred to as the photographic subject luminosity area A1 and A2) set up by the photographic subject luminosity area setting part 69. In this case, as shown in drawing 3, inclination of each photographic subject luminosity area A1 and the compression characteristic of A2 is first made into zero, the photographic subject luminosity area A1 by the side of low-intensity -- the photographic subject luminosity area A1 near the luminance value Xs of the compression starting point S, if it puts in another way, setting it as the same level position as the compression start level Ys -- on the other hand -- the photographic subject luminosity area A2 by the side of high-intensity -- the photographic subject luminosity area A2 near maximum luminance compression point M', if it puts in another way, For example, while changing into the photographic subject luminosity area A1 and the state where A2 was made to estrange by a predetermined compression amount, by setting it as the same level position as Lighting Sub-Division compression level L'max, The compression characteristic is determined that the photographic subject luminosity area A1 between the compression starting point S and maximum luminance compression point M' and the characteristic portion shown in the remaining numerals 311-313 other than A2 will be in the state connected in a straight line, i.e., the state with fixed inclination. An outputted part (an outputted part between Ys and L'max) of the portion shown in the compression characteristic of the above-mentioned numerals 312 at least can produce the lightness difference (luminance difference) between the photographic subject luminosity area A1 and A2 when setting up the compression characteristic by arranging the photographic subject luminosity area A1 and A2 in this way.
[0057]
Thus, the level position of each photographic subject luminosity area, It is not limited to the level position of the compression starting point S to not necessarily mention above and maximum luminance compression point M' so that mutual lightness difference may be acquired in short, For example, as shown in the height (it is henceforth called level height) 701 and 702 from the output level zero shown in drawing 9, it may be set as the photographic subject luminosity area A1 and the arbitrary levels according to A2. Also in this case, the remaining portion is set up like the above have fixed inclination. It may opt for setting out of this level height, for example according to whether the peak P1 of each

photographic subject luminosity area and the luminance value of P2 are how much separated from the luminance value Xs of the compression starting point S and maximum luminance compression point M', and Xmax, respectively (making it be proportional to clearance).

[0058]

As shown in drawing 10, when three or more photographic subject luminosity area exists, (Here, it is referred to as three, the photographic subject luminosity area A11, A12, and A13), For example, the photographic subject luminosity area A11 near the luminance value Xs of the compression starting point S is set as the compression start level Ys and the level, Set the photographic subject luminosity area A13 near maximum luminance compression point M' as Lighting Sub-Division compression level L'max and the level, and the photographic subject luminosity area A12 in the meantime, It is good also as what is called the stair-like compression characteristic as it is set as the level height according to the distance of the compression starting point S or maximum luminance compression point M', and the peak value of this photographic subject luminosity area A12. However, if the lightness difference between each photographic subject luminosity area is acquired suitably, It is not limited to this setting method, for example, may set the photographic subject luminosity area A12 as the compression start level Ys, or Lighting Sub-Division compression level L'max and the level, and, The photographic subject luminosity area A11 and A13 may be set as arbitrary level height like the case of drawing 9, without considering it as the same level position as compression start level Ys and Lighting Sub-Division compression level L'max. The remaining characteristic portion is set up like the above also in this case have fixed inclination.

[0059]

Next, the compression characteristic in the field of less than the compression start level Ys is determined. The compression characteristic of the Lighting Sub-Division ingredient L of less than this compression start level Ys is given with the characteristic function shown in the following (8) types.

L'=exp(log (L) *c) *n ... (8)

However, "c" is DR compression ratio and "n" is a normalization paragraph.

The compression characteristic shown in this (8) type is obtained when DR compression of the Lighting Sub-Division ingredient L which is the characteristic graph 320 in drawing 3, and is shown in the above-mentioned numerals 310 is carried out with the DR compression ratio c. However, the field shown in the numerals 321 of less than the compression start level Ys in the characteristic graph 320 serves as the compression characteristic (compression characteristic 321) set up with less than the compression start level Ys here.

[0060]

DR compression of the Lighting Sub-Division ingredient L which has a dynamic range of the above 0 - Ymax is carried out by this DR compression at Lighting Sub-Division ingredient L' which is settled in 0 (zero) below Omax - the dynamic range of L'max. This Omax is the output maximum (it may be the output maximum or the maximum pixel value of the image pick-up sensor 3) of a predetermined generating picture system, for example, takes the gradation value of "255" in 8 bit images. Function L' which shows the Lighting Sub-Division ingredient after DR compression shown in the above-mentioned (8) formula, compression -- the starting point -- S (Xs, Ys) -- maximum luminance -- a

compression point -- M -- ' (Xmax, L'max) -- two -- a point -- passing -- a sake -- these -- a point -- S -- and -- M -- ' -- a coordinate value -- respectively -- substituting -- obtaining -- having -- simultaneous equations -- from -- (-- eight --) -- an equation -- it can set -- being concerned -- two -- a ** -- an unknown -- c -- n -- being computable .

[0061]

However, introducing a parameter "n" in the above-mentioned (8) formula in addition to a compression parameter "c", For example, the outputted image (taken image) of the image pick-up sensor 3 has a dynamic range (8 bit images) of zero to 255 gradation, When Lighting Sub-Division ingredient L' after DR compression becomes the gradation of 0-100, it is because adjustment (normalization of Lighting Sub-Division ingredient L') of increasing the whole gradation value 2.5 times by setting the value of "n" to 2.5 is enabled in order to double this with the gradation of 0-255. The Lighting Sub-Division ingredient compression zone 70 since the compression characteristic of the above-mentioned (8) formula passes along maximum luminance compression point M' (Xmax, L'max) below Omax, That is [level L'max after compression becomes small so that the reflectance Rhi is high], based on DR compression ratio which determined DR compression ratio and was this determined that a compression ratio will become large, the Lighting Sub-Division ingredient L can be referred to as being what carries out DR compression.

[0062]

The Lighting Sub-Division ingredient compression zone 70 sets up the compression characteristic 330 which consists of the compression characteristic (compression characteristic 331) shown in the numerals 331 more than compression start level Ys calculated as mentioned above, and the compression characteristic 321 of less than the compression start level Ys, and performs DR compression based on this compression characteristic 330.

[0063]

Setting up the compression starting point S in DR compression to the Lighting Sub-Division ingredient L, Are for not carrying out DR compression of the main object luminosity, as mentioned above, and therefore, the Lighting Sub-Division ingredient compression zone 70, Although the compression characteristic 330 of having the above-mentioned compression characteristic 321 in DR compression to the Lighting Sub-Division ingredient L is used, the Lighting Sub-Division ingredient L performs processing which makes the source image I an output value in the field of less than the compression start level Ys, without using Lighting Sub-Division ingredient L' obtained with the compression characteristic 330 concerned as an output value.

[0064]

an image generation part -- 71 -- Lighting Sub-Division -- an ingredient -- a compression zone -- 70 -- having asked -- Lighting Sub-Division -- an ingredient -- L -- ' -- reflectance -- an ingredient -- a calculation part -- 65 -- having asked -- reflectance -- an ingredient -- R -- from -- the following -- (-- nine --) -- a formula -- a source image -- I -- receiving -- being new -- a picture -- I -- ' (picture I' after color dodge processing) -- generating -- a thing -- it is .

I'=L'*R ... (9)

[0065]

By color dodge processing by DR compression based on the above compression

characteristics 330. For example, raising the contrast of the portion of the building 501 of a picture, as shown in drawing 5. . For example, the lightness difference of the empty 502 corresponding to the above-mentioned photographic subject luminosity area A1 and the portion of the clouds 503 corresponding to the photographic subject luminosity area A2 becomes small, and the white jump etc. have not arisen (or the lightness difference of the empty 502 concerned and the clouds 503 in a source image is maintained). The natural (it is suitable) picture which was effective can be acquired now.

[0066]

Drawing 6 is a flow chart which shows an example of the operation about the color dodge processing by the digital camera 1 in this embodiment. First, characteristic unification processing to a linear characteristic is performed by the characteristic converter 62, and the picture It is acquired (Step S1). Next, based on edge maintenance filter (nonlinear filter) processing, the Lighting Sub-Division ingredient L is extracted from the picture It by the Lighting Sub-Division component extraction part 63. However, extracting processing of this Lighting Sub-Division ingredient is simultaneously performed to all the pixels of the picture It (Step S2). And while the compression start level Ys is set as the compression starting point set part 64, When it is distinguished by the Lighting Sub-Division ingredient compression zone 68 that it is more than compression start level Ys to which the Lighting Sub-Division ingredient L was set, (YES of Step S3), The reflectance ingredient R is computed by the reflectance ingredient calculation part 65 (step S4), The compression starting point S (compression start level Ys) and maximum luminance compression point M' (Lighting Sub-Division compression level L'max), And based on the compression characteristic set up based on the information on photographic subject luminosity area (here the two photographic subject luminosity area A1, A2), DR compression of the above-mentioned Lighting Sub-Division ingredient L is carried out, and Lighting Sub-Division ingredient L' is obtained (Step S5). The operation flow of this step S5 is explained in full detail in drawing 7 below. This step S4, the reflectance ingredient R obtained by five, and Lighting Sub-Division ingredient L' to picture I' is generated and outputted (Step S6). In the above-mentioned step S3, when it is distinguished that the Lighting Sub-Division ingredient L is less than the compression start level Ys, (NO of Step S3) and the source image I are chosen and outputted (Step S7). However, sequential execution (as opposed to one pixel) of the operation of Steps S3-S7 is carried out for every pixel of the Lighting Sub-Division ingredient L. Thus, if processing of Steps S3-S7 is completed to all the pixels (YES of Step S8), it will become the end of a flow. If it has not completed to all the pixels (NO of Step S8), it returns to Step S3, and each processing of the steps S3-S7 concerned is repeated until all the pixels are completed.

[0067]

Drawing 7 is a flow chart which shows an example of more detailed operation of DR compression processing in the above-mentioned step S5. At Step S5, the reflectance Rhi (maximum or average value) of a high luminance section is first computed by the high luminance region reflectance calculation part 66 from the reflectance ingredient R computed by the reflectance ingredient calculation part 65 (Step S21). Next, maximum luminance compression point M' is computed by the maximum luminance compression point calculation part 67 based on the reflectance Rhi computed by the high luminance region reflectance calculation part 66. Specifically, Lighting Sub-Division compression

level L'max is computed from the reflectance Rhi and the output maximum Omax using the above-mentioned (7.3) formula (Step S22). Next, from this histogram, the peak histograms 411 and 412 are computed by the histogram operation part 68 by the histogram of the Lighting Sub-Division ingredient picture being created, and by the photographic subject luminosity area setting part 69. Based on the peak information of these peak histograms 411 and 412, etc., the photographic subject luminosity area A1 and A2 are computed. And in the field more than compression start level Ys by the Lighting Sub-Division ingredient compression zone 70, It changes into each photographic subject luminosity area A1 and the state where used A2 as the compression start level Ys, and Lighting Sub-Division compression level L'max and the level, respectively, and it was made to estrange by predetermined pressure contraction amount, On the other hand, the compression characteristic 330 which made the field of less than the compression start level Ys the part of the characteristic graph 320 which passes along two points of the compression starting point S and maximum luminance compression point M' is set up (Step S23). And based on this compression characteristic 330, DR compression of the Lighting Sub-Division ingredient L is carried out by the Lighting Sub-Division ingredient compression zone 70 (Step S24).

[0068]

As mentioned above, according to the imaging device (digital camera 1) of this embodiment. object light being picturized by the image pick-up sensor 3, and the Lighting Sub-Division ingredient L being extracted from the taken image (the source image I or the picture It) boiled and twisted in the image pick-up sensor 3 by the Lighting Sub-Division component extraction part 63, and, The reflectance ingredient R is extracted from a taken image by the reflectance ingredient calculation part 65 (calculation), and by a compression characteristic setting-out means (the photographic subject luminosity area setting part 69, the Lighting Sub-Division ingredient compression zone 70). While at least two predetermined fields (for example, the photographic subject luminosity area A1, A2) to a taken image or the Lighting Sub-Division ingredient L are set up, the compression characteristic 330 of emphasizing the lightness difference between each field concerned is set up. And the dynamic range of the Lighting Sub-Division ingredient L extracted by the above-mentioned Lighting Sub-Division component extraction part 63 based on the compression characteristic 330 set up by the Lighting Sub-Division ingredient compression zone 70 by the above-mentioned compression characteristic setting-out means is compressed (DR compression carried out), A new picture (picture I') is generated by the image generation part 71 from Lighting Sub-Division ingredient L' (compression Lighting Sub-Division ingredient) and the reflectance ingredient R into which this dynamic range was compressed. The compression characteristic that this emphasizes the lightness difference between at least two predetermined regions set up to the taken image or the Lighting Sub-Division ingredient L (between the photographic subject luminosity area A1 and A2) is set up, Since the dynamic range of the Lighting Sub-Division ingredient L is compressed based on this compression characteristic, in color dodge processing, the natural picture which could enlarge lightness difference of the Lighting Sub-Division ingredient in the necessary field of a picture, and was effective by extension can be acquired.

[0069]

The compression characteristic which inclination is zero and changes the portion

corresponding to each field (the photographic subject luminosity area A1, A2) of the characteristic line which shows the compression characteristic into the state where it was made to estrange mutually by a predetermined compression amount (the level Ys and an outputted part between L'max), by the above-mentioned compression characteristic setting-out means is set up. Thus, since the compression characteristic is set up by the method of changing into the state where made inclination to each field into zero, and it was made to estrange by a predetermined compression amount mutually, the compression characteristic that the lightness difference between predetermined regions is emphasized can be obtained easily.

[0070]

The histogram of a taken image (the source image I or the picture It) or the Lighting Sub-Division ingredient L is created by the histogram operation part 68, and the prescribed range on the luminosity in a histogram is set up as each field (the photographic subject luminosity area A1, A2) by the above-mentioned compression characteristic setting-out means. Thus, since the prescribed range on the luminosity in a histogram is set up as each field, when processing a picture, each field concerned can be easily set up using the histogram generally created.

[0071]

By the above-mentioned compression characteristic setting-out means, the peak of a histogram is computed and the prescribed range consisting mainly of this peak or a peak near position is set up as each field (the photographic subject luminosity area A1, A2). Thus, each field which used the histogram can be easily set up by the method of setting up the prescribed range centering on the peak or peak near position of a histogram as each field.

[0072]

. Receive the Lighting Sub-Division ingredient L by the compression starting point set part 64 (the 1st level value setting-out means). It is set up by the compression start level Ys (the 1st level value) more than the main object luminosity which shows the predetermined luminance value of a main object, and by the maximum luminance compression point calculation part 67 (the 2nd level value setting-out means). Lighting Sub-Division compression level L'max (the 2nd level value) below the predetermined generating picture maximum (output maximum Omax) according to the reflectance Rhi in the high luminance region of the reflectance ingredient R to the Lighting Sub-Division ingredient L is set up. And the predetermined region (here photographic subject luminosity area A1) by the side of low-intensity [of each field (the photographic subject luminosity area A1, A2)] is used as the compression start level Ys and the level by the above-mentioned compression characteristic setting-out means, The compression characteristic 330 which uses the predetermined region (here photographic subject luminosity area A2) by the side of high-intensity as Lighting Sub-Division compression level L'max and the level is set up. By thus, the method of setting up the compression characteristic which uses the predetermined region by the side of low-intensity [of each field] as the compression start level Ys and the level, and uses the predetermined region by the side of high-intensity as Lighting Sub-Division compression level L'max and the level. The compression characteristic that the lightness difference between each field is emphasized can be easily set up now.

[0073]

In [according to the image processing method of this embodiment, in the 1st process, object light is picturized by the image pick-up sensor 3, and] the 2nd process, In [the Lighting Sub-Division ingredient L is extracted from the taken image (the source image I or the picture It) by the image pick-up sensor 3 by the Lighting Sub-Division component extraction part 63, and] the 3rd process, In [the reflectance ingredient R is extracted from a taken image by the reflectance ingredient calculation part 65 (calculation), and] the 6th process, While at least two predetermined fields (for example, the photographic subject luminosity area A1, A2) to a taken image or the Lighting Sub-Division ingredient L are set up by a compression characteristic setting-out means, the compression characteristic of emphasizing the lightness difference between each field concerned is set up. And in [the dynamic range of the Lighting Sub-Division ingredient extracted / above-mentioned / by the compression means in the 4th process based on the compression characteristic set up by the compression characteristic setting-out means is compressed, and] the 5th process, A new picture (picture I') is generated by the image generation part 71 from Lighting Sub-Division ingredient L' (compression Lighting Sub-Division ingredient) and the reflectance ingredient R into which this dynamic range was compressed. The compression characteristic that this emphasizes the lightness difference between at least two predetermined regions set up to the taken image or the Lighting Sub-Division ingredient L (between the photographic subject luminosity area A1 and A2) is set up, Since the dynamic range of the Lighting Sub-Division ingredient L is compressed based on this compression characteristic, in color dodge processing, the natural picture which could enlarge lightness difference of the Lighting Sub-Division ingredient in the necessary field of a picture, and was effective by extension can be acquired.

[0074]

The portion corresponding to each field (the photographic subject luminosity area A1, A2) of the characteristic line which shows the compression characteristic by a compression characteristic setting-out means in the 6th process of the above, The compression characteristic which inclination is zero and is changed into the state where it was made to estrange mutually by a predetermined compression amount (the level Ys and an outputted part between L'max) is set up. Thus, since the compression characteristic is set up by the method of changing into the state where made inclination to each field into zero, and it was made to estrange by a predetermined compression amount mutually, the compression characteristic that the lightness difference between predetermined regions is emphasized can be obtained easily.

[0075]

In the 7th process of the above, the histogram of a taken image (the source image I or the picture It) or the Lighting Sub-Division ingredient L is created by the histogram operation part 68, and the prescribed range on the luminosity in a histogram is set up as each field by a compression characteristic setting-out means in the 6th process. Thus, since the prescribed range on the luminosity in a histogram is set up as each field, when processing a picture, each field can be easily set up using the histogram generally created.

[0076]

This invention can take the following modes.

(A) As the shape of the compression characteristic of the Lighting Sub-Division ingredient that photographic subject luminosity area is set up is shown in the compression characteristic 330 of drawing 3 in the above-mentioned embodiment, have become stair-

like, i.e., shape which incline in photographic subject luminosity area and connected zero and other characteristic portions in a straight line, but. As it is not limited to the such-shaped compression characteristic, for example, is shown in drawing 11, it may be the composition that the curve-like compression characteristic that are the information at which inclination of the portion equivalent to photographic subject luminosity area maintained abbreviated zero (becoming a flat graph), and each part was connected smoothly is set up.

[0077]

(B) As it is not limited to the above-mentioned maximum or average value and the reflectance Rhi does not exceed [the reflectance ingredient of a high luminance region] the output maximum Omax, as long as it is a suitable value to set up the DR compression ratio c, it may be which value.

[0078]

(C) The taken image (source image) treated in the above-mentioned color dodge processing, . Even if it is not above-mentioned linearity / logarithmic picture, are well based on a common linear sensor. It may be the wide dynamic range image created from the picture of two or more sheets acquired by taking a photograph with different shutter speed and diaphragm value, and may be the picture (picture which applied to which and compressed the predetermined gain only into bright picture Wakebe (high luminance region)) by which knee processing was carried out.

[0079]

(D) As for less than the compression start level Ys, after carrying out DR compression of the whole Lighting Sub-Division ingredient L in the above-mentioned embodiment, it is good not to be the method of using the source image I, For example, it may be the method of making the source image I a deed (DR compression is not performed to the Lighting Sub-Division ingredient L of less than the compression start level Ys), and less than the compression start level [compression / to the Lighting Sub-Division ingredient L concerned / DR] Ys only to the Lighting Sub-Division ingredient L more than compression start level Ys with an output value as it is.

[0080]

(E) In the above-mentioned embodiment, although color dodge processing (DR compression processing) to a taken image is considered as the composition performed within the digital camera 1 (image processing portion 6), it is good also as composition performed in the predetermined treating part not only this but besides the digital camera 1. . The network connection by the digital camera 1, direct continuation (cable), or wireless LAN was specifically made, for example using USB etc. Or a storage medium etc. which are called a memory card. The predetermined host having the user interface which used and was constituted so that signal transduction was possible (for example, good also as composition which performs the color dodge processing concerned in PC (Personal Computer) or PDA (Personal Digital Assistant))

[0081]

(F) In the above-mentioned embodiment, as shown in drawing 4, compute the histogram of the taken image (whole) or the Lighting Sub-Division ingredient (whole) first, and are considering each photographic subject luminosity area as the composition set up as a prescribed range on the luminosity in this histogram, but. For example, as shown in drawing 5, a taken image (or the Lighting Sub-Division ingredient picture) is displayed

on a monitor etc. of the host who shows the monitor section 9 or the above-mentioned modification mode (E) of the digital camera 1, The range of the part in this picture by which the monitor display was carried out which wants to emphasize lightness difference mutually (at least two ranges), Namely, for example, the prescribed range (designated ranges 511 and 512) of the empty picture shown in the numerals 511 and 512, or a cloud picture, It is good also as composition to which a user specifies as a spatial range of a picture, and sets photographic subject luminosity area based on the picture information of this designated range by predetermined alter operation with a mouse, a pen, etc. By thus, the above-mentioned compression characteristic setting-out means (hosts, such as the photographic subject luminosity area setting part 69 of the digital camera 1 and the Lighting Sub-Division ingredient compression zone 70, or the above-mentioned PC). Since photographic subject luminosity area is set up based on the picture of this range while the spatial range in a taken image or the Lighting Sub-Division ingredient (Lighting Sub-Division ingredient picture) is set up, a user can choose a part [a part] to make it emphasize the lightness difference in a picture visually (intuitive) and easily.

[0082]

The setting method of photographic subject luminosity area based on the picture of the above-mentioned designated range, Like the method of setting up photographic subject luminosity area based on the information on the whole (the Lighting Sub-Division ingredient whole) taken image described by the above-mentioned embodiment, Namely, a histogram is created based on the picture information of this designated range for every designated range, It may be the method of computing a peak histogram by a cut-off point operation from this histogram, computing a peak from this peak histogram further, and setting up the prescribed range consisting mainly of this peak or a peak near position as photographic subject luminosity area. the luminance range and peak of a luminance histogram of a picture -- the same -- or, although an overlapped part may be produced in a luminance range, [in / case of this method / each designated range] When a luminance range and a peak will become the same (it approximates), In performing DR compression using the usual (lightness difference between these luminance ranges is not emphasized) compression characteristic of not setting up photographic subject luminosity area and producing an overlapped part in a luminance range, It is preferred to adjust the cut-off point level at the time of peak histogram calculation (threshold), or to adjust the range at the time of photographic subject luminosity area setting so that the influence of this overlapped part may be lost.

[Brief Description of the Drawings]

[0083]

[Drawing 1]It is a digital camera which is an example of the imaging device concerning this embodiment, and is a rough block lineblock diagram concerning image pick-up processing to the Lord of this digital camera.

[Drawing 2]It is a functional block diagram for explaining each function of the image processing portion of the above-mentioned digital camera.

[Drawing 3]They are the graph charts for explaining the color dodge processing (situation of compression of the Lighting Sub-Division ingredient) by gray-scale-conversion processing of a described image treating part.

[Drawing 4]They are the graph charts for explaining creation of the histogram from a taken image, and setting out of photographic subject luminosity area based on a

histogram.
[Drawing 5]It is a mimetic diagram for explaining the situation of change of the lightness difference of each part of a taken image by the color dodge processing by the above-mentioned digital camera.
[Drawing 6]It is a flow chart which shows an example of the operation about the color dodge processing by the digital camera in this embodiment.
[Drawing 7]It is a flow chart which shows an example of more detailed operation of DR compression processing in Step S5 shown in drawing 6.
[Drawing 8]It is a mimetic diagram showing the state of division of the imaging region for matrix metering (photometry range).
[Drawing 9]They are the graph charts for explaining the modification mode about setting out of photographic subject luminosity area.
[Drawing 10]They are the graph charts for explaining the modification mode about setting out of photographic subject luminosity area.
[Drawing 11]They are the graph charts for explaining the modification mode about setting out of photographic subject luminosity area.
[Drawing 12]They are the graph charts for explaining the conventional color dodge processing.
[Drawing 13]They are the graph charts for explaining the conventional color dodge processing.
[Drawing 14]It is a mimetic diagram showing the situation of change of the lightness difference of each part of a taken image in the conventional color dodge processing.
[Drawing 15]They are graph charts showing the situation of compression of the Lighting Sub-Division ingredient in the conventional color dodge processing.
[Description of Notations]
[0084]
1 Digital camera (imaging device)
3 Image pick-up sensor (imaging means)
6 Image processing portion
63 Lighting Sub-Division component extraction part (Lighting Sub-Division component extraction means)
64 Compression starting point set part (the 1st level value setting-out means)
65 Reflectance ingredient calculation part (reflectance component extraction means)
66 High luminance region reflectance calculation part
67 Maximum luminance compression point calculation part (the 2nd level value setting-out means)
68 Histogram operation part (histogram preparing means)
69 Photographic subject luminosity area setting part (compression characteristic setting-out means)
70 Lighting Sub-Division ingredient compression zone (a compression means, compression characteristic setting-out means)
71 Image generation part (picture generation means)
330 Compression characteristic
511 and 512 Designated range (the spatial prescribed range according to claim 4)
A1 and A2 Photographic subject luminosity area (two predetermined fields given in Claim 1, each field)

Ys Compression start level (the 1st level value)
L'max Lighting Sub-Division compression level (the 2nd level value)

TECHNICAL FIELD

[Field of the Invention]
[0001]
This invention relates to the image processing method which may be applied to imaging devices, such as a digital camera, the imaging device which has a dynamic-range-compression function especially, and this.

PRIOR ART

[Background of the Invention]
[0002]
In recent years, in imaging devices, such as a digital camera, it is one big theme to make the luminance range of the photographic subject which an image pick-up sensor can treat, i.e., a dynamic range, (DR) expand with the request of high-definition-izing. By using the subthreshold level characteristic of MOSFET, concerning expansion of a dynamic range. The image pick-up sensor (it is called a linear log sensor) which has a photoelectric transfer characteristic which consists of an image pick-up sensor which has the characteristic that an electrical signal is changed in logarithm according to incident light quantity in the output characteristics by the side of high-intensity, i.e., a linear-characteristics field, and a logarithmic characteristic area is known. Since the output from which the linear log sensor was changed in natural logarithm to incident light quantity as mentioned above is obtained, a larger dynamic range is secured compared with the image pick-up sensor which has the photoelectric transfer characteristic of only a linear-characteristics field.
[0003]
While extensive dynamic range-ization of an imaging system progresses like the above-mentioned linear log sensor, even if extensive dynamic range-ization of the display system of a monitor etc. does not progress like an imaging system under the present circumstances but extensive dynamic range-ization of an inputted image is attained, In a display system, the effect can fully be demonstrated. Therefore, it is necessary to make the dynamic range of this inputted image compress so that the inputted image of an extensive dynamic range is settled in the dynamic range of a display system.
[0004]
By the way, for "compression of a dynamic range." The meaning which raises contrast (gradation) by adjusting the light and darkness of a picture locally, namely, compressing the Lighting Sub-Division ingredient of a picture, and where the relation of the light and darkness of the whole picture is maintained as it was, Although there are two meanings with the meaning (a picture is uniformly compressed regardless of local light-and-darkness adjustment) which compresses a zone (dynamic range) literally, the former shall be called "color dodge processing" and the latter shall be called "DR compression" in order to distinguish these.
[0005]

the above from the Lighting Sub-Division ingredient concerned by which DR compression was carried out after extracting the Lighting Sub-Division ingredient, for example from a picture (a reflectance ingredient is also extracted at this time) and carrying out DR compression of this Lighting Sub-Division ingredient by color dodge processing conventionally, and a reflectance ingredient -- the new picture to which the light and darkness of the picture were adjusted locally is generated. With the art currently indicated by the patent documents 1, concerning this. These pictures are combined, after carrying out division extraction of the picture (it is henceforth called linearity / logarithmic picture) which has the photoelectric transfer characteristic of the linear characteristics and the logarithmic characteristic which were obtained by the linear log sensor at the log picture I1 and the linear picture I2 and performing color dodge processing by each picture, as shown in drawing 12. If this image composing is made into picture I' shown in drawing 13, DR compression to the source image I as an inputted image, i.e., above-mentioned linearity / logarithmic picture, will be performed so that this picture I' may be settled in the dynamic range of an outputted image (for example, the above-mentioned display system).
[Patent documents 1] Patent Application No. 2004-377875

EFFECT OF THE INVENTION

[Effect of the Invention]
[0019]
Since according to the imaging device concerning Claim 1 the compression characteristic of emphasizing the lightness difference between at least two predetermined regions set up to the taken image or the Lighting Sub-Division ingredient is set up and the dynamic range of the Lighting Sub-Division ingredient is compressed based on this compression characteristic, In color dodge processing, the natural picture which could enlarge lightness difference of the Lighting Sub-Division ingredient in the necessary field of a picture, and was effective by extension can be acquired.
[0020]
Since the compression characteristic is set up by the method of changing into the state where made inclination to each field into zero, and it was made to estrange by a predetermined compression amount mutually according to the imaging device concerning Claim 2, the compression characteristic that the lightness difference between predetermined regions is emphasized can be obtained easily.
[0021]
Since the prescribed range on the luminosity in a luminance histogram is set up as each field according to the imaging device concerning Claim 3, when processing a picture, each field concerned can be easily set up using the luminance histogram generally created.
[0022]
Since the spatial prescribed range in a taken image or the Lighting Sub-Division ingredient is set up as each field according to the imaging device concerning Claim 4, For example, it becomes possible to set up each field and a part [a part] (each field) to make it emphasizing the lightness difference in a picture can be chosen now visually (intuitive) and easily because a user specifies a prescribed range to the taken image (or the Lighting

Sub-Division ingredient picture) by which the monitor display was carried out.
[0023]
According to the imaging device concerning Claim 5, each field which used the luminance histogram can be easily set up by the method of setting up the prescribed range centering on the peak or peak near position of a luminance histogram as each field.
[0024]
According to the imaging device concerning Claim 6, the predetermined region by the side of low-intensity [of each field] can be used as the 1st level value and the level, and the compression characteristic that the lightness difference between each field is emphasized can be easily set up by the method of setting up the compression characteristic which uses the predetermined region by the side of high-intensity as the 2nd level value and the level.
[0025]
According to the image processing method concerning Claim 7, the compression characteristic of emphasizing the lightness difference between at least two predetermined regions set up to the taken image or the Lighting Sub-Division ingredient is set up, Since the dynamic range of the Lighting Sub-Division ingredient is compressed based on this compression characteristic, in color dodge processing, the natural picture which could enlarge lightness difference of the Lighting Sub-Division ingredient in the necessary field of a picture, and was effective by extension can be acquired.
[0026]
Since the compression characteristic is set up by the method of changing into the state where made inclination to each field into zero, and it was made to estrange by a predetermined compression amount mutually according to the image processing method concerning Claim 8, the compression characteristic that the lightness difference between predetermined regions is emphasized can be obtained easily.
[0027]
Since the prescribed range on the luminosity in a luminance histogram is set up as each field according to the image processing method concerning Claim 9, when processing a picture, each field concerned can be easily set up using the luminance histogram generally created.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]
[0006]
However, in the art shown in the above-mentioned patent documents 1. By color dodge processing which is going to raise the contrast of the portion of the building 141 of a picture as the shade difference of the Lighting Sub-Division ingredient is shortened, namely, it is shown, for example in drawing 14, since the total luminance level of the Lighting Sub-Division ingredient is compressed uniformly. For example, the lightness difference of the empty 142 and the portion of the clouds 143 will become small (the empty 142 and the cloud 143 whole serving as what is called a picture that white-flew), and it will be a thin picture what is called with little contrast to which the contrast in the whole picture fell (picture). this -- drawing 15 -- being shown -- as -- being certain -- a picture -- ******** -- for example, -- about -- two -- twice -- luminance difference (difference D1 of the pixel value assumed) -- having -- luminosity -- A -- B

(photographic subjects A and B) -- having seen -- a case -- Lighting Sub-Division -- an ingredient -- compression -- this -- luminosity -- A -- B -- it can set -- a pixel value -- A -- ' -- B -- ' -- a difference -- D -- two -- small -- becoming -- things -- depending .

[0007]

In light of the above-mentioned circumstances in color dodge processing, an object of this invention is to provide the imaging device and image processing method which can acquire the natural picture which could enlarge lightness difference of the Lighting Sub-Division ingredient in the necessary field of a picture, and was effective by extension.

MEANS

[Means for Solving the Problem]

[0008]

An imaging means in which an imaging device concerning Claim 1 of this invention picturizes object light, A Lighting Sub-Division component extraction means to extract the Lighting Sub-Division ingredient from a taken image by said imaging means, A reflectance component extraction means to extract a reflectance ingredient from said taken image, and a compression means which compresses a dynamic range of the Lighting Sub-Division ingredient extracted by said Lighting Sub-Division component extraction means based on the predetermined compression characteristic, A picture generation means which generates a new picture from a compression Lighting Sub-Division ingredient for which said compression means comes to compress a dynamic range of the Lighting Sub-Division ingredient, and a reflectance ingredient extracted by said reflectance component extraction means, While setting up at least two predetermined fields to said taken image or said Lighting Sub-Division ingredient, Having a compression characteristic setting-out means to set up said compression characteristic of emphasizing lightness difference between each field concerned, said compression means compresses a dynamic range of said Lighting Sub-Division ingredient based on the compression characteristic set up by said compression characteristic setting-out means.

[0009]

According to the above-mentioned composition, object light is picturized by imaging means and the Lighting Sub-Division ingredient is extracted from a taken image by an imaging means by the Lighting Sub-Division component extraction means, While a reflectance ingredient is extracted from a taken image by reflectance component extraction means and at least two predetermined fields to a taken image or the Lighting Sub-Division ingredient are set up by a compression characteristic setting-out means, the compression characteristic of emphasizing lightness difference between each field concerned is set up. And a new picture is generated from a compression Lighting Sub-Division ingredient and a reflectance ingredient into which a dynamic range of the Lighting Sub-Division ingredient extracted [above-mentioned] by compression means based on the compression characteristic set up by a compression characteristic setting-out means was compressed into, and this dynamic range was compressed by picture generation means.

[0010]

An imaging device concerning Claim 2 sets up the compression characteristic changed into the state where said compression characteristic setting-out means made portion of

each other [inclination is zero and] corresponding to said each field of a characteristic line which shows the compression characteristic estrange by a predetermined compression amount in Claim 1. According to this composition, the compression characteristic which inclination is zero and changes a portion corresponding to each field concerned of a characteristic line which shows the compression characteristic into the state where it was made to estrange by a predetermined compression amount mutually, by a compression characteristic setting-out means is set up.

[0011]

An imaging device concerning Claim 3 is further provided with a histogram preparing means which creates a luminance histogram of said taken image or the Lighting Sub-Division ingredient in Claim 1 or 2, and said compression characteristic setting-out means sets up a prescribed range on luminosity in a luminance histogram as said each field. According to this composition, a luminance histogram of a taken image or the Lighting Sub-Division ingredient is created by histogram preparing means, and a prescribed range on luminosity in a luminance histogram is set up as each field by a compression characteristic setting-out means.

[0012]

As for an imaging device concerning Claim 4, in either of the Claims 1-3, said compression characteristic setting-out means sets up said each field based on a picture of this prescribed range while setting up a spatial prescribed range in said taken image or said Lighting Sub-Division ingredient. According to this composition, by a compression characteristic setting-out means, while a spatial prescribed range in a taken image or the Lighting Sub-Division ingredient is set up, each field is set up based on a picture of this prescribed range.

[0013]

In Claim 3 or 4, said compression characteristic setting-out means computes a peak of said luminance histogram, and an imaging device concerning Claim 5 sets up a prescribed range consisting mainly of this peak or a peak near position as said each field. According to this composition, by a compression characteristic setting-out means, a peak of a luminance histogram is computed and a prescribed range consisting mainly of this peak or a peak near position is set up as each field.

[0014]

A 1st level value setting-out means to set up the 1st level value more than main object luminosity an imaging device concerning Claim 6 indicates a predetermined luminance value of a main object over said Lighting Sub-Division ingredient to be in either of the Claims 1-5, It has further a 2nd level value setting-out means against said Lighting Sub-Division ingredient to set up the 2nd level value below the predetermined generating picture maximum according to reflectance in a high luminance region of said reflectance ingredient, Said compression characteristic setting-out means uses a predetermined region by the side of low-intensity [of said each field] as said 1st level value and the level, and the compression characteristic which uses a predetermined region by the side of high-intensity as said 2nd level value and the level is set up. According to this composition, by the 1st level value setting-out means, it is set up by the 1st level value more than main object luminosity which shows a predetermined luminance value of a main object over the Lighting Sub-Division ingredient, and by the 2nd level value setting-out means. The 2nd level value below the predetermined generating picture

maximum according to reflectance in a high luminance region of a reflectance ingredient over the Lighting Sub-Division ingredient is set up. And by a compression characteristic setting-out means, a predetermined region by the side of low-intensity [of each field] is used as the 1st level value and the level, and the compression characteristic which uses a predetermined region by the side of high-intensity as the 2nd level value and the level is set up.

[0015]

The 1st process at which an image processing method concerning Claim 7 picturizes object light by an imaging means, The 2nd process of extracting the Lighting Sub-Division ingredient from a taken image by said imaging means by the Lighting Sub-Division component extraction means, The 3rd process of extracting a reflectance ingredient from said taken image by a reflectance component extraction means, The 4th process of compressing a dynamic range of the Lighting Sub-Division ingredient extracted by said Lighting Sub-Division component extraction means based on the predetermined compression characteristic by a compression means, The 5th process of generating a new picture by a picture generation means from a compression Lighting Sub-Division ingredient for which said compression means comes to compress a dynamic range of the Lighting Sub-Division ingredient, and a reflectance ingredient extracted by said reflectance component extraction means, While setting up at least two predetermined fields to said taken image or said Lighting Sub-Division ingredient, Have the 6th process of setting up said compression characteristic of emphasizing lightness difference between each field concerned, by a compression characteristic setting-out means, and said 4th process, It is characterized by being the process of compressing a dynamic range of said Lighting Sub-Division ingredient by a compression means based on the compression characteristic set up by said compression characteristic setting-out means.

[0016]

In [according to the above-mentioned composition, object light is picturized by imaging means in the 1st process, and] the 2nd process, In [the Lighting Sub-Division ingredient is extracted from a taken image by an imaging means by the Lighting Sub-Division component extraction means, and] the 3rd process, In [a reflectance ingredient is extracted from a taken image by reflectance component extraction means, and] the 6th process, While at least two predetermined fields (the below-mentioned photographic subject luminosity area) to a taken image or the Lighting Sub-Division ingredient are set up by a compression characteristic setting-out means, the compression characteristic of emphasizing lightness difference between each field concerned is set up. And in [a dynamic range of the Lighting Sub-Division ingredient extracted / above-mentioned / by compression means in the 4th process based on the compression characteristic set up by a compression characteristic setting-out means is compressed, and] the 5th process, A new picture is generated by picture generation means from a compression Lighting Sub-Division ingredient and a reflectance ingredient into which this dynamic range was compressed.

[0017]

In Claim 7, an image processing method concerning Claim 8 said 6th process, It is characterized by being the process of setting up the compression characteristic which inclination is zero and changes a portion corresponding to said each field of a characteristic line which shows the compression characteristic into the state where it was

made to estrange by a predetermined compression amount mutually, by a compression characteristic setting-out means. According to this composition, in the 6th process, the compression characteristic which inclination is zero and changes into the state where it was made to estrange by a predetermined compression amount mutually a portion corresponding to said each field of a characteristic line which shows the compression characteristic by a compression characteristic setting-out means is set up.

[0018]

An image processing method concerning Claim 9 has further the 7th process of creating a luminance histogram of said taken image or the Lighting Sub-Division ingredient by a histogram preparing means, in Claim 7 or 8, and said 6th process by a compression characteristic setting-out means. It is characterized by being the process of setting up a prescribed range on luminosity in a luminance histogram as said each field. According to this composition, in the 7th process, a luminance histogram of a taken image or the Lighting Sub-Division ingredient is created by histogram preparing means, and a prescribed range on luminosity in a luminance histogram is set up as each field by a compression characteristic setting-out means in the 6th process.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[0083]

[Drawing 1]It is a digital camera which is an example of the imaging device concerning this embodiment, and is a rough block lineblock diagram concerning image pick-up processing to the Lord of this digital camera.

[Drawing 2]It is a functional block diagram for explaining each function of the image processing portion of the above-mentioned digital camera.

[Drawing 3]They are the graph charts for explaining the color dodge processing (situation of compression of the Lighting Sub-Division ingredient) by gray-scale-conversion processing of a described image treating part.

[Drawing 4]They are the graph charts for explaining creation of the histogram from a taken image, and setting out of photographic subject luminosity area based on a histogram.

[Drawing 5]It is a mimetic diagram for explaining the situation of change of the lightness difference of each part of a taken image by the color dodge processing by the above-mentioned digital camera.

[Drawing 6]It is a flow chart which shows an example of the operation about the color dodge processing by the digital camera in this embodiment.

[Drawing 7]It is a flow chart which shows an example of more detailed operation of DR compression processing in Step S5 shown in drawing 6.

[Drawing 8]It is a mimetic diagram showing the state of division of the imaging region for matrix metering (photometry range).

[Drawing 9]They are the graph charts for explaining the modification mode about setting out of photographic subject luminosity area.

[Drawing 10]They are the graph charts for explaining the modification mode about setting out of photographic subject luminosity area.

[Drawing 11]They are the graph charts for explaining the modification mode about

setting out of photographic subject luminosity area.
[Drawing 12]They are the graph charts for explaining the conventional color dodge processing.
[Drawing 13]They are the graph charts for explaining the conventional color dodge processing.
[Drawing 14]It is a mimetic diagram showing the situation of change of the lightness difference of each part of a taken image in the conventional color dodge processing.
[Drawing 15]They are graph charts showing the situation of compression of the Lighting Sub-Division ingredient in the conventional color dodge processing.